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RAPID GROWTH OF LARGE-SCALE (20-50cm) KDP CRYSTALS

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KH_2PO_4 (KDP) and $K(D_xH_{1-x)2}PO_4$ (DKDP) crystals are, at present, the only nonlinear crystals which can be grown to the sizes (30-80 cm) needed for laser radiation conversion in laser fusion systems. There are many problems associated with the growth of such crystals by the traditional technique, due primarily to the low growth rates (1 mm/day) and long growth periods. A new, fast-growth technique recently developed at Moscow State University, allows us to grow KDP crystals at rates that are an order of magnitude or more larger than those achieved with traditional methods [1]. This technique is based on the method of temperature reduction starting from a "point seed" with a size of about 1 cm^3 independent of the final size of the crystal.

KDP and DKDP crystals with sizes up to 160 mm had been grown previously in crystallizers with a maximum volume of 20 L at the growth rates of up to 50 mm/day. Investigations of optical quality (anomalous biaxiality, absorption spectra, light scattering, effective nonlinear susceptibility, and wave front distortion) [2,3] showed that rapidly grown crystals can be as good as those grown by the traditional methods.

Here we report the growth of KDP crystals of up to 45x45cm in cross section in 1000L crystallizers using this technique. Crystals were grown starting from a saturation point of about 65°C. The stability of the growth solutions against spontaneous nucleation was as high as in small crystallizers [4]. Relative supersaturations of up to 50% were achieved during continuous cooling. At a constant supersaturation of 6% (T=60°C), stirred solutions were without spontaneous crystals for periods of more than 1.5 months. These conditions allowed us to perform stable growth at the rates of 10-20 mm/day, without generating spontaneous crystals during the whole process of about 1 month. The primary issues associated with scaling the crystallizers from 10-20 L to 1,000 L are connected with deformations of the crystal platform and changes in hydrodynamic conditions. We will discuss these issues and the specific changes to the small-scale crystallizer design which enabled us to achieve growth of large crystals.

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